(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Veröffentlichungsnummer:
(11) Publication number:
(11) Numéro de publication:

0 607 250

Internationale Anmeldung veræffentlicht durch die Weltorganisation fßr geistiges Eigentum unter der Nummer:

WO 93/07724 (art.158 des EP*f*).

International application published by the World Intellectual Property Organisation under number:

WO 93/07724 (art.158 of the EPC).

Demande internationale publieà par l'Organisation Mondiale de la Propriàtà sous le numàro:

WO 93/07724 (art.158 de la CBE).

BNSDOCID: <EP 0607250A0 I >

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:
H04Q 7/04, 11/04, H04B 7/26 H04M 1/00, 1/72	A1	WO 93/07724
		(43) International Publication Date: 15 April 1993 (15.04.93)

(21) International Application Number: PCT/CA92/00444

(22) International Filing Date: 9 October 1992 (09.10.92)

(30) Priority data:
2,053,137 10 October 1991 (10.10.91) CA

(71) Applicant *(for all designated States except US)*: MITEL CORPORATION [CA/CA]; 350 Legget Drive, P.O. Box 13089, Kanata, Ontario K2K 1X3 (CA).

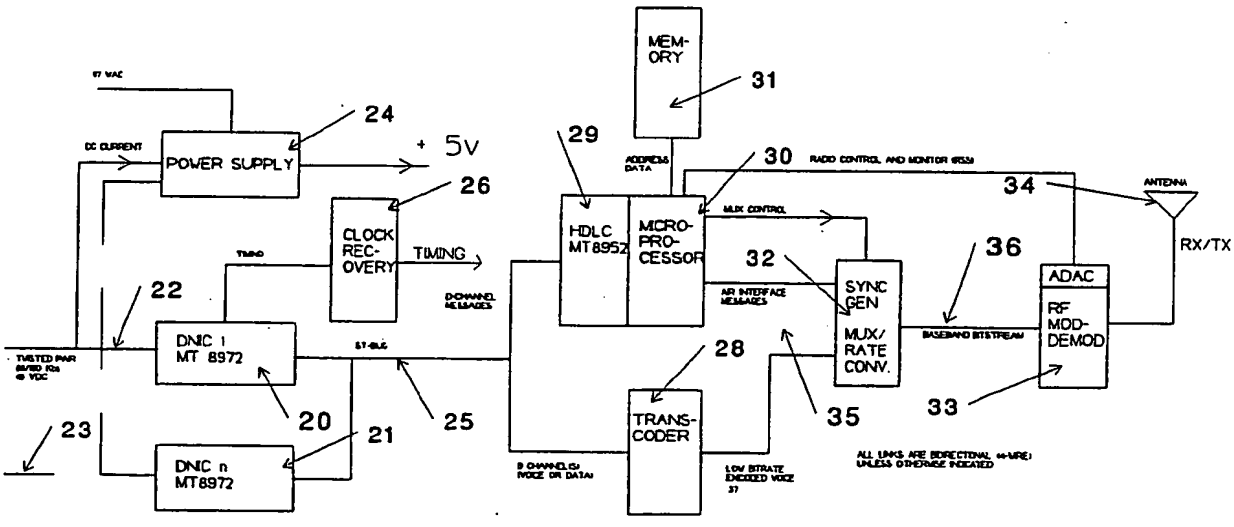
(72) Inventors; and
(75) Inventors/Applicants *(for US only)* : MEIER, Rolf [CA/CA]; R.R. 2, Carp, Ontario K0A 1L0 (CA). BLIGH, Peter [CA/CA]; 18 Grierson Lane, R.R.1, Kanata, Ontario K2K 1X7 (CA).

(74) Agent: MITCHELL, Richard, J.; Marks & Clerk, P.O. Box 957, Station B, Ottawa, Ontario K1P 5S7 (CA).

(81) Designated States: DE, GB, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE).

Published
With international search report.

(54) Title: DIGITAL WIRELESS INTERFACE



(57) Abstract

An apparatus for establishing communication between one or more digital radio channels and one or more digital wireline signals over the digital radio channels, comprising an r.f. unit for transmitting and receiving circuits, a digital interface unit connected to each wireline circuit, a unit for separating incoming signals into bearer channels and signaling information, and a unit for recombining the outgoing bearer channels and signaling information into the appropriate format for transmission over the outgoing medium.

BNSDOCID: <WO 9307724A1 >

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria
AU	Australia
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CS	Czechoslovakia
CZ	Czech Republic
DE	Germany
DK	Denmark
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IT	Italy
JP	Japan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
LI	Liechtenstein
LK	Sri Lanka
LU	Luxembourg
MC	Monaco
MG	Madagascar
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SK	Slovak Republic
SN	Senegal
SU	Soviet Union
TD	Chad
TG	Togo
UA	Ukraine
US	United States of America
VN	Viet Nam

BNSDOCID: <WO 9307724A1 >

DIGITAL WIRELESS INTERFACE

This invention relates to an apparatus for establishing communication between one or more digital radio channels and one or more digital wireline circuits.

Wireless telephones, such as cellular telephones, have been developed which employ digital modulation to communicate signaling, voice and synchronization. Such systems require a means of interfacing them to the public wireline network (Public Switch Telephone Network - PSTN). Prior art systems perform this function by converting the digital radio signals to standard analog signals, which are then transmitted to the PSTN.

By performing a digital-to-analog conversion each time data are transmitted between the wireline and wireless networks, many of the advantages of digital signaling are lost. It is accordingly an object of the present invention to alleviate this disadvantage.

According to the present invention there is provided an apparatus for establishing communication between one or more digital radio channels and one or more digital wireline circuits, comprising an r.f. unit for transmitting and receiving signals over said digital radio channels, a digital interface unit connected to each wireline circuit, means for separating incoming signals into bearer channels and signaling information, and means for recombining the outgoing bearer channels and signaling information into the appropriate format for transmission over the outgoing medium. DECT, spread spectrum, or other systems can be used for the radio channels.

BNSDOCID: <WO 9307724A1 | >

The invention provides a means of interfacing radio signals to the PSTN (Public Switched Telephone Network) or ISDN (Integrated Services Digital Network) either through a PBX (using a DNIC, for example) or directly, (using a Primary Rate Interface (PRI) or a Base Rate Interface (BRI), for example) while maintaining the advantages of digital encoding of voice and using message-based signaling.

By using a DNIC (Digital Network Interface Circuit) device, it is possible to locate the wireless base station remotely from the switching system in order to optimize the radio coverage of the base stations by allowing flexible location of the base stations.

In one embodiment the interface units, which are standard DNIC units, are connected to a standard ST serial bus. This in turn is connected to a multiplexer/demultiplexer unit, which separates the D (data) channels from the B (bearer) channels. The D channels are then interpreted to extract signaling information, which is passed through UART (Universal Asynchronous Receiver Transmitter) to the r.f. unit, where the signaling information is recombined with the bearer information for onward transmission over the radio channels. The system works in reverse for signals received over the digital radio channels.

The digital wireline circuits are preferably basic rate circuits operating at 192 kbps and offering two bearer (B) channels at 128 kbps and one data (D) channel 16 kbps. The remaining bits are used for control purposes. The r.f. section preferably uses a CT2 standard format.

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a block diagram of an apparatus in accordance with the invention.

Referring now to Figure 1, a DNIC interface 20, (and optionally additional DNIC interfaces 21) is connected to respective twisted pairs of copper wires 22, 23 carrying a data at a rate of 80/160 kbps in full duplex mode for each pair of wires. The base rate channels provide a signaling "D" channel and one or more, usually two, "B" channels carrying voice or data.

The twisted pairs provide a 48 volt DC voltage feed to power supply 24, which is capable of converting the DC appearing on the line into a voltage suitable for powering the apparatus. As an alternative, the power supply 24 can be connected to 117 volts AC supply. Power supply 24 provides a 5 volt output.

The DNICs 20, 21 convert the incoming line code into standard ST bus format and apply it to ST bus 25, which carries a 2.048 mbps stream. The D and B channels can be extracted from this bus according to a predetermined sequence of channel assignments. Other serial bit stream rates can be employed, but the 2.048 standard is most convenient in the context of the present invention.

By connecting multiple DNIC input devices in parallel to the same ST bus, higher bit rates can be achieved. The additional twisted copper pairs can also be used to add additional power to the power supply if more power is required by the station. Each DNIC unit

BNSDOCID: <WO 9307724A1 >

20, 21 communicates to the remote switching system over a separate twisted pair.

The use of a standard ST bus allows other interfaces to be used instead of DNIC if desired.

The clock recovery block 26 is connected to the DNIC in order to provide the required timing signals to the invention. In particular, the system provides an 8 kHz frame pulse signal, which can be used to generate a synchronization signal for the purpose of synchronizing the operation of multiple base stations.

The voice or data channels are routed to MUX unit 32. In some applications, a voice processing unit 28 is required. This consists of a DSP (Digital Signal Processor), containing a predetermined sequence of operations that are performed on the information stream(s). A typical application would be voice compression, wherein the digitally-encoded voice is reduced in data rate while maintaining high information content, thereby preserving bandwidth on the radio channel. An example of such an algorithm can be found in the CCITT document G.721.

However, some applications can be implemented without the use of a DSP block, for example if the information stream is already compressed into the format required for the radio interface.

The signaling information on the "D" channel is routed to a HDLC (High-level Data Link control) controller 29, which performs the layer 2 functions of the protocol on the "D" channel. It should be noted that some protocols can be implemented without the use of an HDLC controller, and that this block is included

only for reference in the event that the HDLC format is required.

The signaling information on the "D" channel sometimes called "messages", is analyzed by a microprocessor 30. Various functions are performed by the microprocessor on these messages:

1) The messages from a PBX or PSTN are interpreted according to whether they are meant for the base station itself, or for subsequent transmission to the wireless telephone, and similarly, the messages from the wireless telephone are interpreted according to whether they are intended for the base station or for subsequent transmission to the PBX or PSTN. This may be done by means of a message type byte.

2) In the event that the messages are intended for the base station, they are acted on by the processor according to the requirements of the message. An example of such a message might be a request to adjust the output level of the base station.

3) In the event that messages are intended to communicate between the wireless telephone and the PBX or PSTN, the messages are either passed transparently through the base station, or, if required, the messages are changed in format such that they may be interpreted correctly by the intended recipient. This may be done by means of a look-up table, stored in the microprocessor's memory 31.

In addition, the same microprocessor 30 performs the link access protocol as required by the radio interface standard. Such protocols have been defined in a number of standards, such as IETS-300-131

BNSDOCID: <WO 9307724A1 >

(otherwise known as the CT2 Common Air Interface) and the DECT standard. These standards contain all the algorithms necessary for establishing the radio link, as well as a definition of the air interface messages required for communication with the wireless handset.

The multiplexer/demultiplexer circuit 32 combines and separates the air interface messages 35 and low-bit-rate encoded voice channels 37 such that a single baseband bit stream 36 is available for a radio transceiver. This circuit is under control of the microprocessor in order that the signaling and information channels can be combined according to the sequence required by the radio interface. In addition, this block inserts and decodes a predetermined sequence of "synch" bits, which are used to synchronize the transceiver in the remote terminal with the transceiver in the base station.

The RF (radio frequency) unit 33 is a known module which converts the baseband bit stream into a waveform suitable for transmission and reception by radio by means of an antenna 34. In a typical transceiver, one or more carrier frequencies are available as allowed by the particular air interface standard employed. The carrier frequencies are selected by the microprocessor according to a predetermined sequence which is defined by the air interface standard. In addition the transceiver provides information to the microprocessor on the status of the available carrier frequencies, such as signal strength, and interference. The interface between the microprocessor and the RF block is an A-to-D (analog to digital) and D-to-A (digital to analog) converter (ADAC). The microprocessor 30 may also control the amplitude of the transmitted signal.

BNSDOCID: <WO 9307724A1 I >

While the ST bus is commonly available in the telecommunications industry, another type of bus, such as an IOM bus, can also be employed. A variety of standard devices can be connected to this circuit too.

The protocol converter can be implemented in the firmware of the microprocessor, which controls many of the functions of the apparatus. Initially, protocol conversion may be necessary for the proprietary set software, although in the future the protocols will be transparent, using ISDN entirely. Since the apparatus includes a microprocessor, the same processor can be used for handling the radio link protocol within the r.f. module. This can result in a cost reduction and the elimination of the UART function.

BNSDOCID: <WO 9307724A1 >

Claims:

1. An apparatus for establishing communication between one or more digital radio channels and one or more digital wireline circuits, comprising an r.f. unit for transmitting and receiving signals over said digital radio channels, a digital interface unit (DNIC) connected to each wireline circuit, means for separating incoming signals into bearer channels and signaling information, and means for recombining the outgoing bearer channels and signaling information into the appropriate protocol for transmission over the outgoing medium.

2. An apparatus as claimed in Claim 1, wherein the said separating means separates the signals received by the digital interface unit into data (D) and bearer (B) channels, and further comprising means for interpreting the information contained in the D channel as signaling messages, means for synchronizing the timing of said messages with the r.f. unit, and means for combining said signaling messages with the bearer channel signals in the r.f. unit.

3. An apparatus as claimed in Claim 2, wherein the output of the interface units are multiplexed onto a serial bus.

4. An apparatus as claimed in Claim 3, wherein said serial bus is a 2.048 mb/sec ST-bus.

5. An apparatus as claimed in Claim 3, wherein the means for separating the D channels is a multiplexer/demultiplexer.

6. An apparatus as claimed in any one of Claims 1 to

5, further comprising means for extracting power to power the apparatus from the digital circuits.

7. An apparatus as claimed in Claim 2, wherein the means for interpreting the information contained in the D channel is a microprocessor that connects the information between formats appropriate for wireline and r.f. transmission.

8. An apparatus as claimed in Claim 1, wherein said digital interface is a DNIC interface.

9. An apparatus as claimed in Claim 3, comprising a plurality of said digital interface units multiplexed onto a common bus.

BNSDOCID: <WO 9307724A1 >

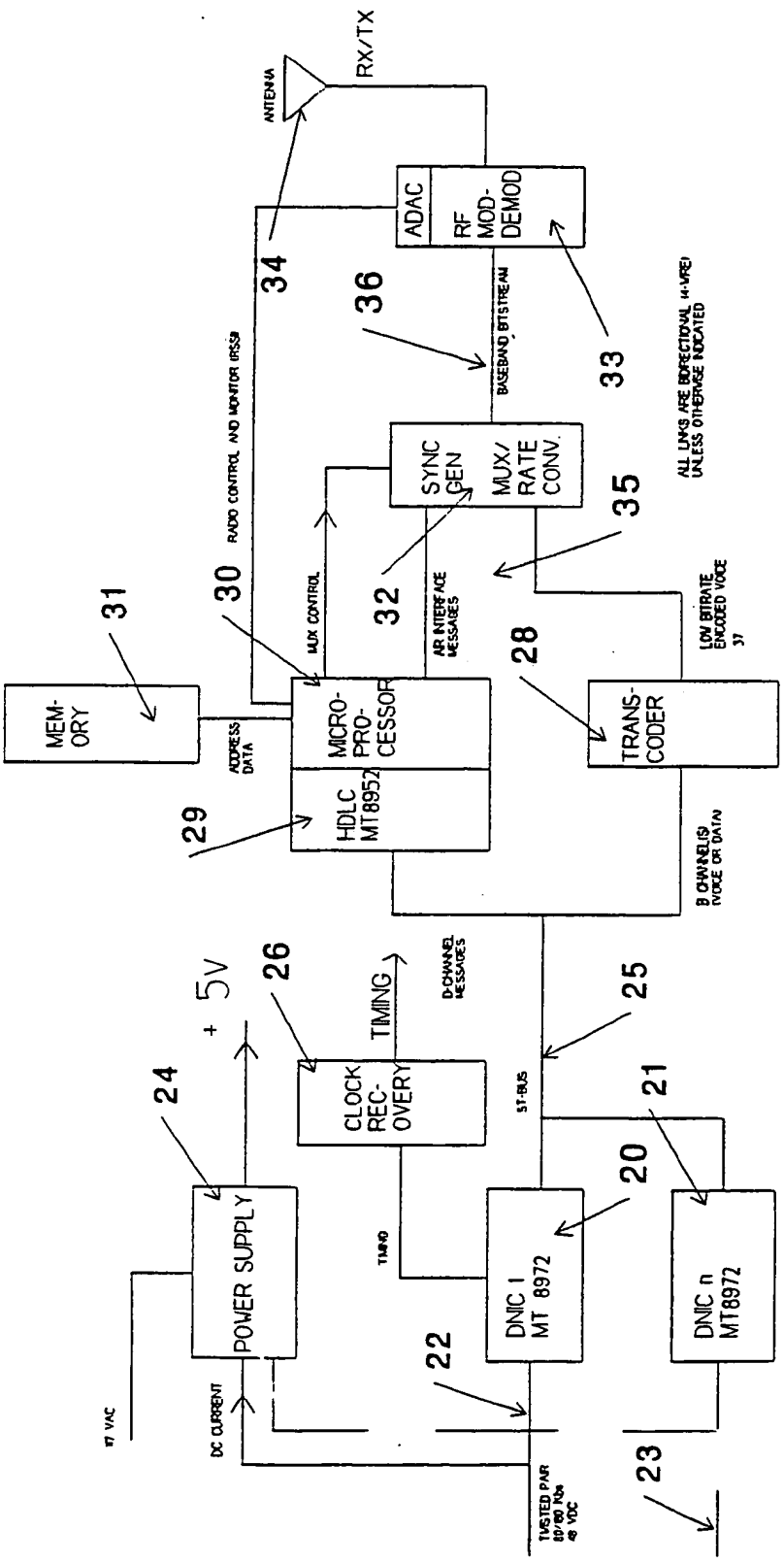


FIGURE 1

SUBSTITUTE SHEET

INTERNATIONAL SEARCH REPORT

International Application No PCT/CA 92/00444

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 H04Q7/04; H04Q11/04; H04B7/26; H04M1/00
H04M1/72

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	H04Q ; H04M

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X Y	EP,A,0 233 963 (ANT) 2 September 1987 see column 6, line 51 - column 8, line 46; figure 4	1,2,7,8 3-5,9
X Y	EP,A,0 168 647 (ANT) 22 January 1986 see page 5, line 18 - page 7, line 12; figure 4	1,2,7,8 3-5,9
X Y	WO,A,9 110 333 (SIEMENS) 11 July 1991 see page 6, line 33 - page 7, line 16 see the whole document	1-2,6-8 3,4,9
Y A	EP,A,0 408 024 (ALCATEL) 16 January 1991 see the whole document	3-5,9 1,2

-/--

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
15 JANUARY 1993	[illegible] 93
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	JANYSZEK J.M.

Form PCT/ISA/210 (second sheet) (January 1985)

BNSDOCID: <WO 9307724A1 >

III. DOCUMENTS CONSIDERED TO EE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with Indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	EDN ELECTRICAL DESIGN NEWS vol. 34, no. 9, April 1989, NEWTON, MASSACHUSETTS US pages 53 - 62 MARKOWITZ 'The U interface comes of age' see the whole document	1-9
A	FERNMELDETECHNISCHE ZEITSCHRIFT FTZ vol. 40, no. 1, January 1987, BERLIN DE pages 70 - 73 HWR 'Europäisches Mobilfunknetz' see the whole document	1,2

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

CA 9200444
SA 65447

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 15/01/93

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A-0233963	02-09-87	None		
EP-A-0168647	22-01-86	None		
WO-A-9110333	11-07-91	AU-A-	7046091	24-07-91
		EP-A-	0506795	07-10-92
		JP-T-	4506594	12-11-92
EP-A-0408024	16-01-91	DE-A-	3923125	24-01-91
		AU-A-	5871390	17-01-91
		CA-A-	2021070	14-01-91
		JP-A-	3148996	25-06-91
WO-A-9110333	11-07-91	AU-A-	7046091	24-07-91
		EP-A-	0506795	07-10-92
		JP-T-	4506594	12-11-92

EPO FORM P0419

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

EN5DOCID: <WO 9207724A1 >

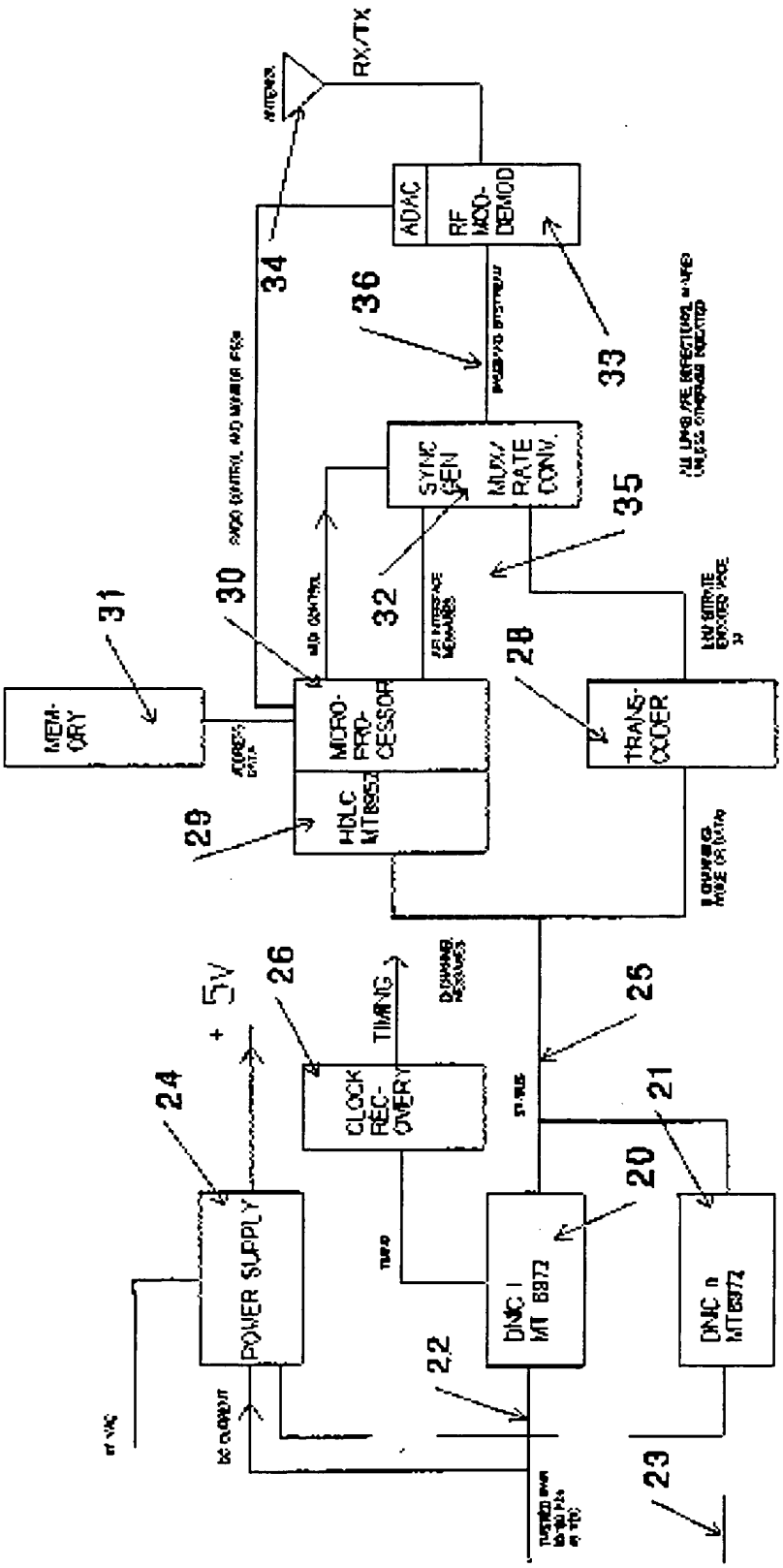


FIGURE 1

SUBSTITUTE SHEET
Best Available Copy